

iCub Skin Tutorial

Andrea Del Prete

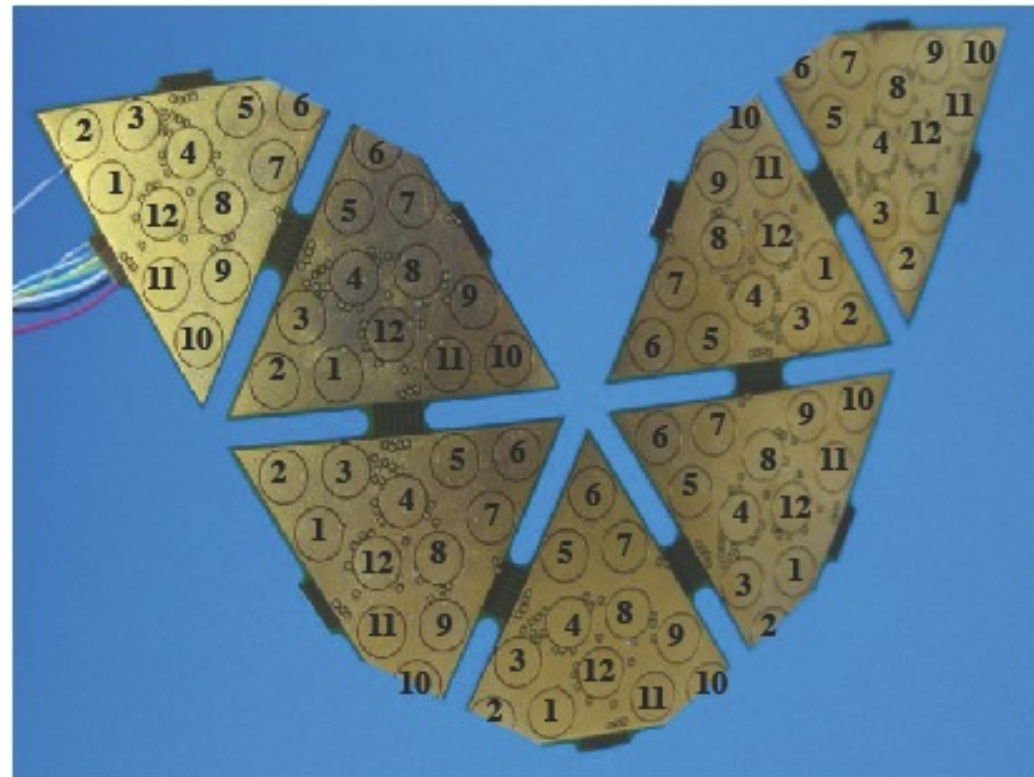
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Basic Information

- Skin data frequency: 50 Hz
- The skin is divided in patches (hand, forearm lower, forearm upper, ...)
- Each patch:
 - has its own microcontroller
 - can read at most 192 values (16 triangles)
 - is organized in triangular modules

Basic Information

- Each triangle contains 12 tactile elements, called taxels



All you need to know

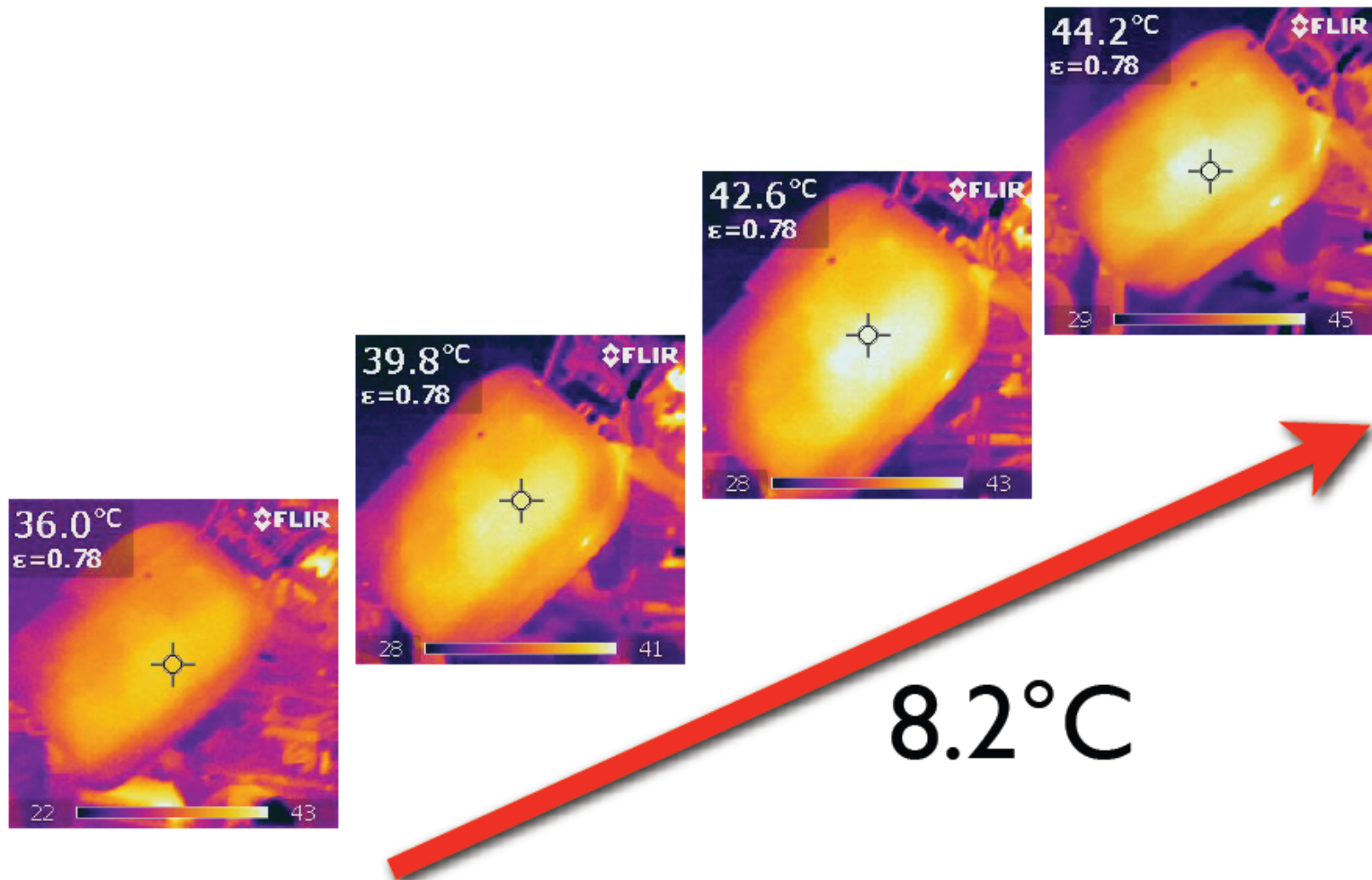
- SkinManager (and skinContact)
- SkinManagerGui
- iCubSkinGui
- (iCubInterface)

SkinManager

- Software module located in:
 - `$ICUB_ROOT/main/src/modules`
- Compensates for the thermal drift of the skin
- Can handle **many input ports** at the same time
- Optionally applies a **low pass filter** to the data
- Computes the **touch threshold** for each taxel
- Compute the **skinContacts**
- Online documentation: http://wiki.icub.org/iCub/main/dox/html/group__icub__skinManager.html

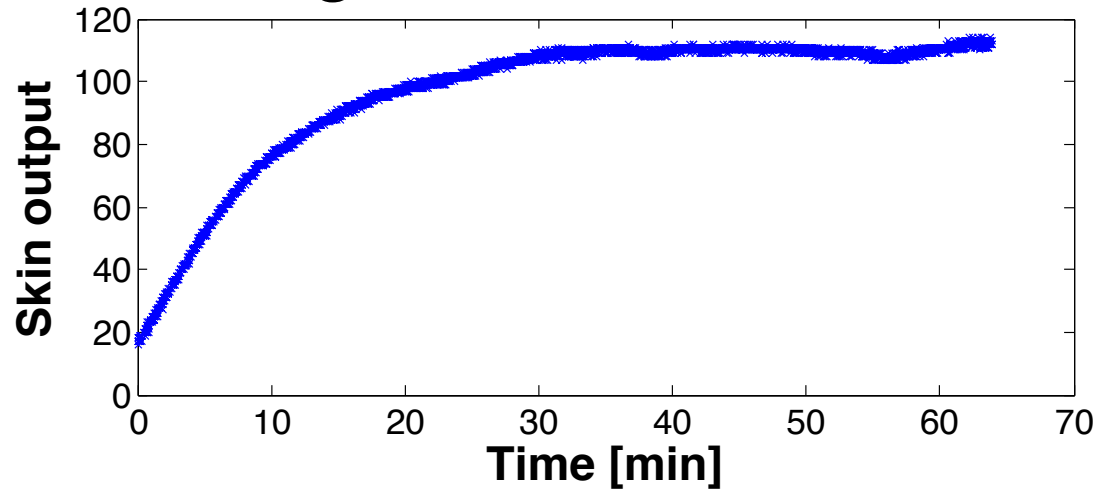
Thermal Drift

17:00 17:15 17:30 17:45

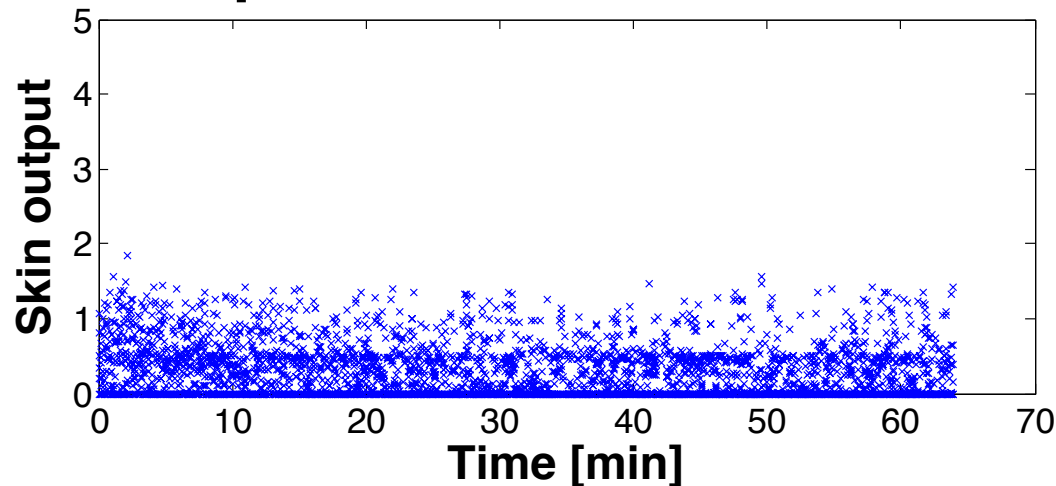


SkinManager

Original values – Taxel66

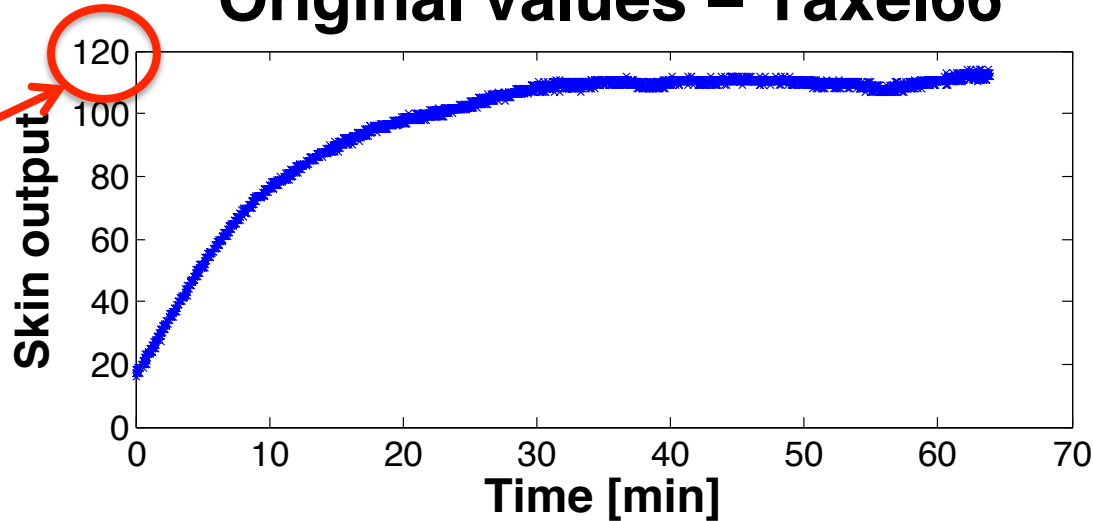


Compensated values – Taxel66

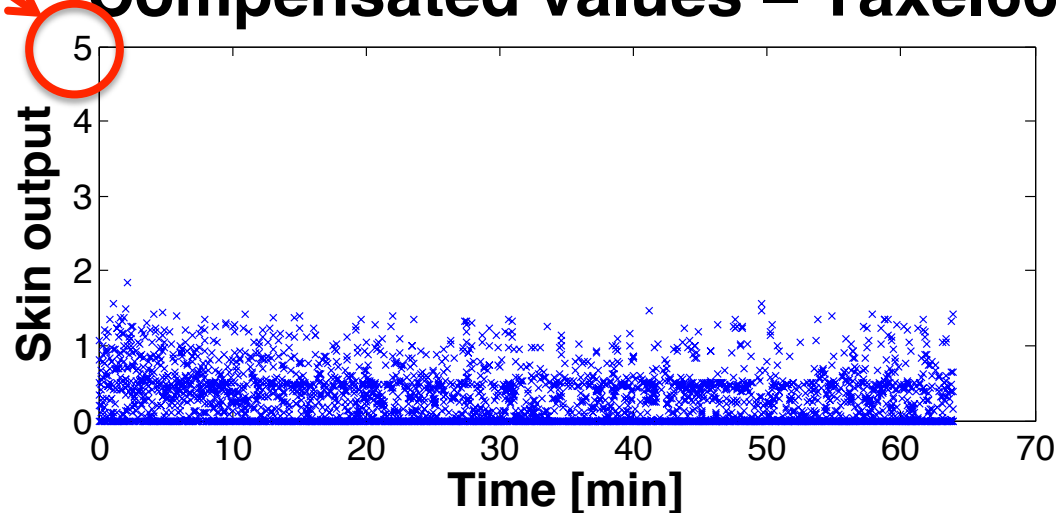


SkinManager

Original values – Taxel66



Compensated values – Taxel66



SkinManager Configuration

```
driftCompLeft.ini CompensationThread.h Compensator.cpp Compensator.h SkinDriftCor

inputPorts (    /icub/skin/left_hand                \
                /icub/skin/left_forearm_lower         \
                /icub/skin/left_arm_upper_bottom      \
                /icub/skin/left_arm_upper_external   \
                /icub/skin/left_arm_upper_internal   \
                /icub/skin/left_arm_lower            \
                /icub/skin/left_forearm_upper         \
                )

outputPorts (   /icub/skin/left_hand_comp              \
                /icub/skin/left_forearm_lower_comp     \
                /icub/skin/left_arm_upper_bottom_comp  \
                /icub/skin/left_arm_upper_external_comp \
                /icub/skin/left_arm_upper_internal_comp \
                /icub/skin/left_arm_lower_comp         \
                /icub/skin/left_forearm_upper_comp     \
                )

period          20
minBaseline     3
zeroUpRawData   false
robot           icub
name            leftSkinDriftComp
smoothFilter
smoothFactor    0.5
```

Raw Skin Output

- Each skin taxel output is a byte (0, 255)
- If there is no pressure the output should be 235 (i.e. the baseline)
- When a pressure is applied the output **decreases**
- In the previous versions of the firmware the baseline value was 244

Compensated Skin Output

- Each skin taxel output is a double in $[0, 255]$
- If there is no pressure the output should be 0
- When a pressure is applied the output **increases**

Touch thresholds

- Each skin taxel is subject to a different noise
- Hence the touch threshold should be different for each taxel
- The SkinManager module computes the touch thresholds (the 95% percentile) during its calibration phase
- Touch thresholds may be retrieved sending a message 'get percentile' to the rpc port of the SkinManager module

SkinContact(List)

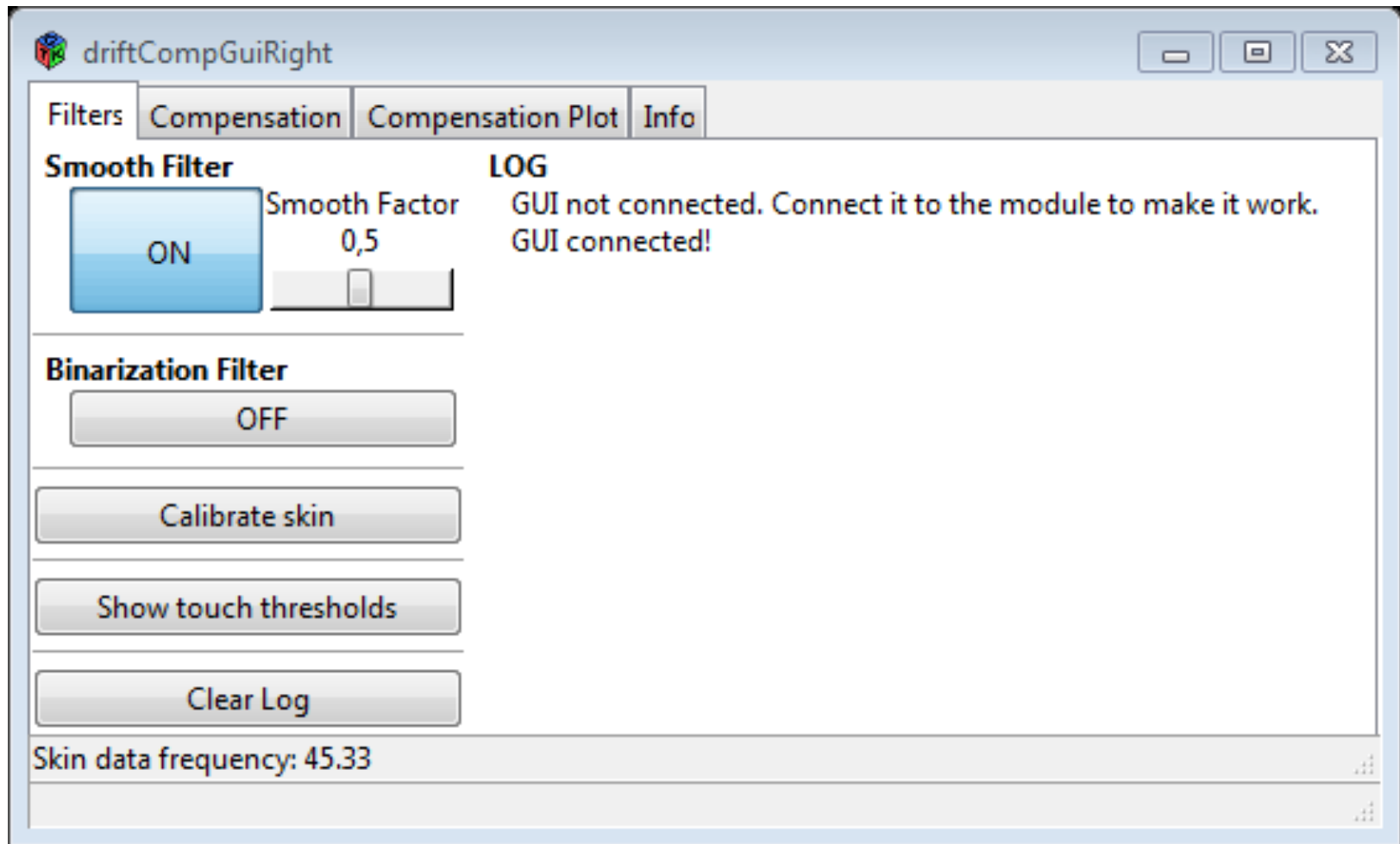
- Class (located in [skinDynLib](#)) representing a contact on the tactile sensor system (skin) of iCub
- Contains info such as: body part, link number, center of pressure, normal direction, indexes of active taxels
- SkinManager writes them on port
 - /skinManager/skin_event:o

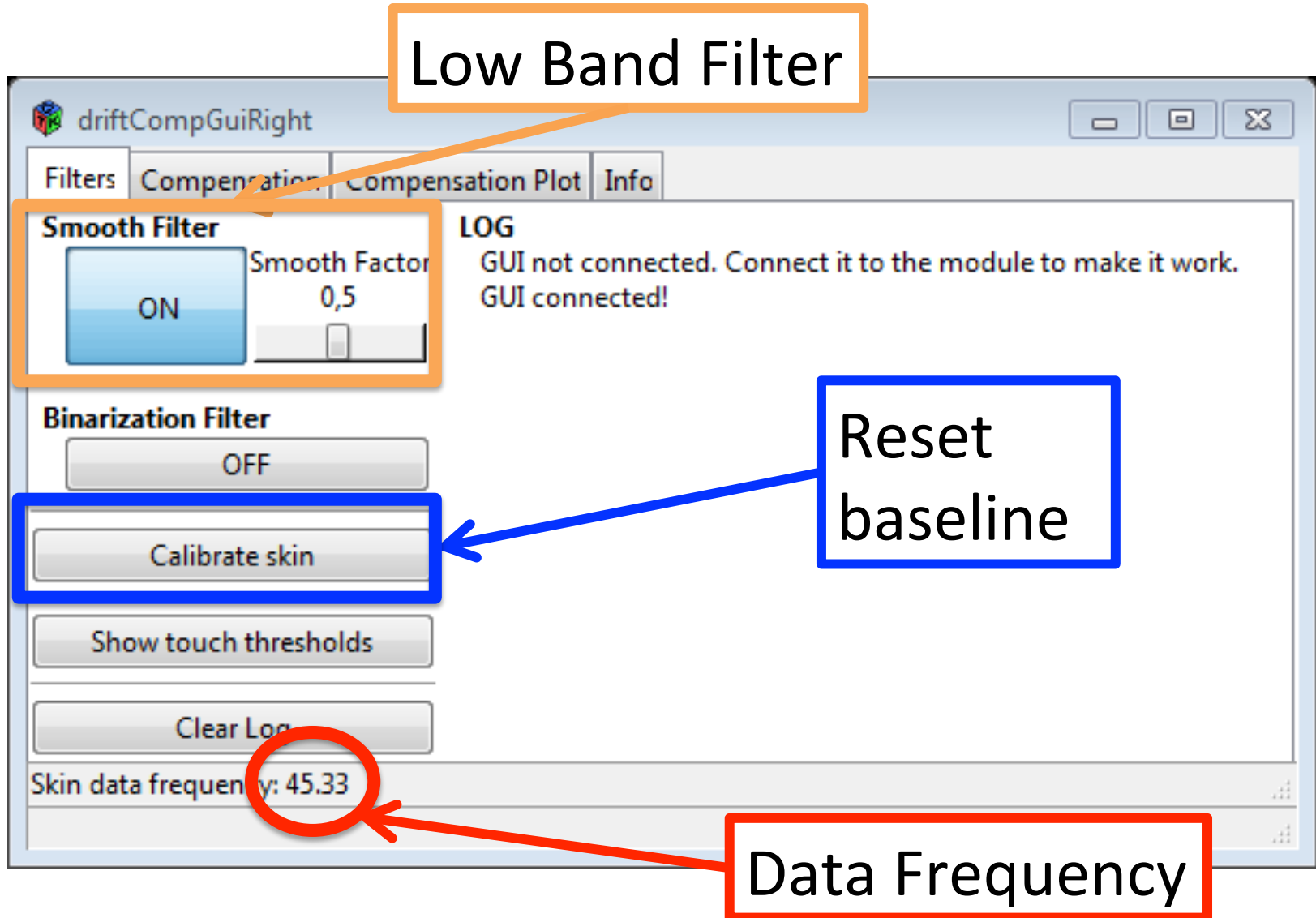
```
BufferedPort<skinContactList> *portSc = new BufferedPort<skinContactList>;
portSc->open(string("/"+local_name+"/skin_contacts:i").c_str());
Network::connect(portSc->getName().c_str(), "/skinManager/skin_events:o","udp");

skinContactList *scl = portSc->read(false);
if(scl != NULL)
{
    map<BodyPart, skinContactList> contactsPerBp = scl->splitPerBodyPart();
    for(map<BodyPart,skinContactList>::iterator it=contactsPerBp.begin(); it!
=contactsPerBp.end(); it++)
    {
        doSomethingWithSkinContact(it);
    }
}
```

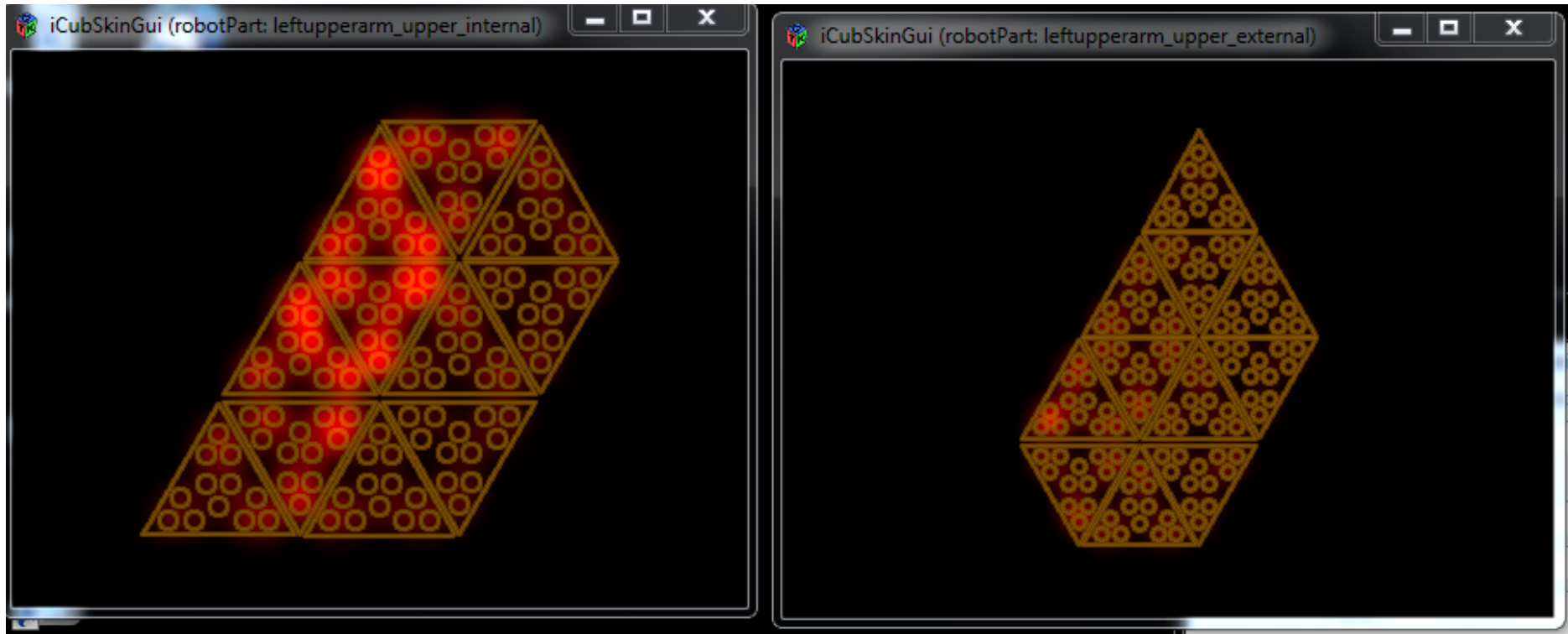
SkinManager GUI

- Located in: `$ICUB_ROOT/main/src/tools`
- A handy alternative to the rpc port of the SkinManager module
- Allows the control of the SkinManager module
- Shows warning and error messages related to the skin (coming from the SkinManager)





iCubSkinGui

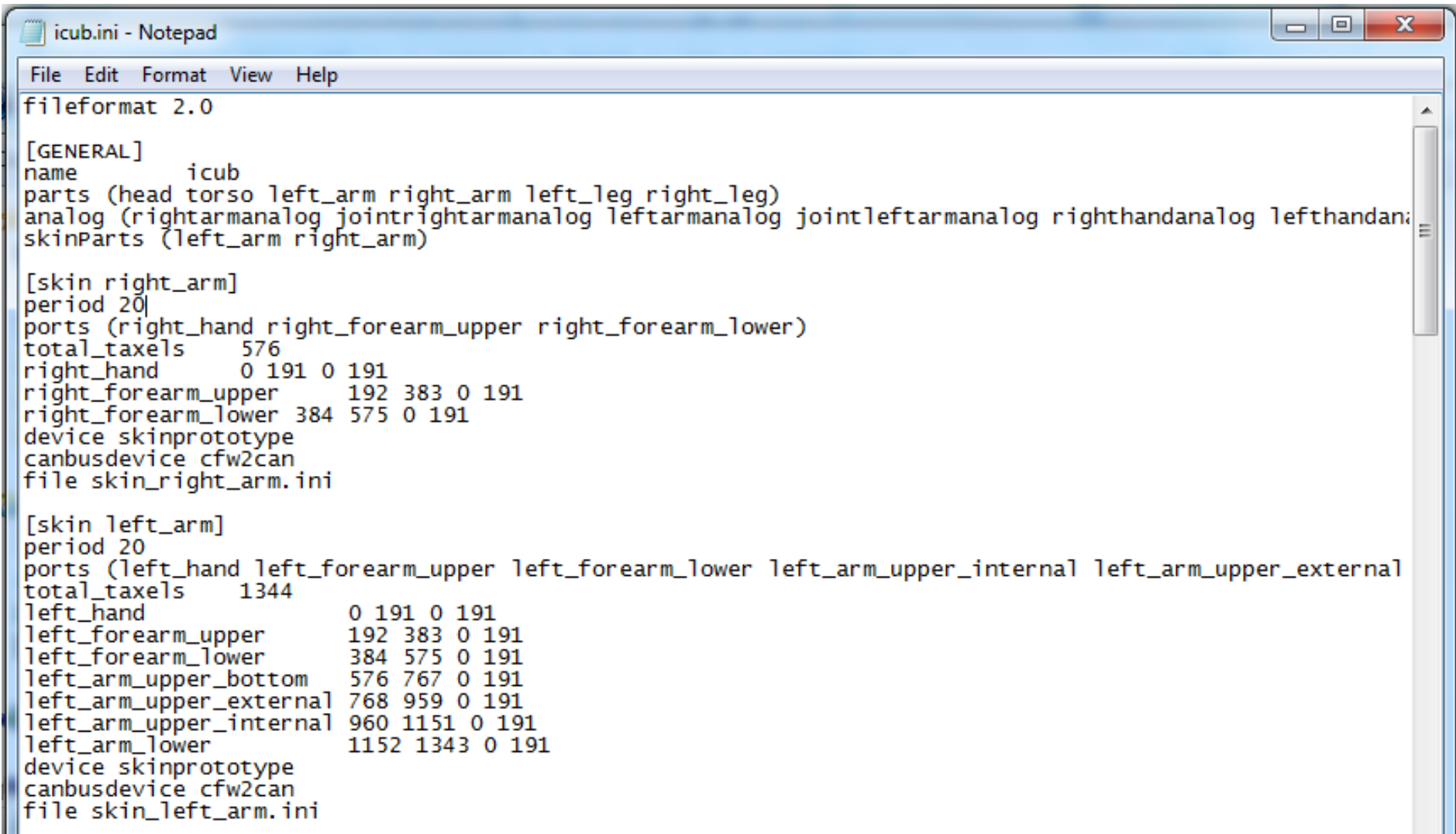


iCubSkinGui

- Located in:
`$ICUB_ROOT/main/src/tools`
- GUI to display the output of fingertips/skin tactile sensors
- Configuration files located in: `$ICUB_ROOT/main/app/skinGui/conf/skinGui`
- If you want to display the compensated skin values run the GUI with the flag
`'useCalibration'`

iCubInterface

- Runs on the PC104 in iCub's head
- Reads the data from the skin sensors
- Sends the data on yarp ports
- All the skin data in one arm are read as one big vector
- The configuration file 'icub.ini' specifies:
 - how the vector has to be split
 - on which port each part has to be sent

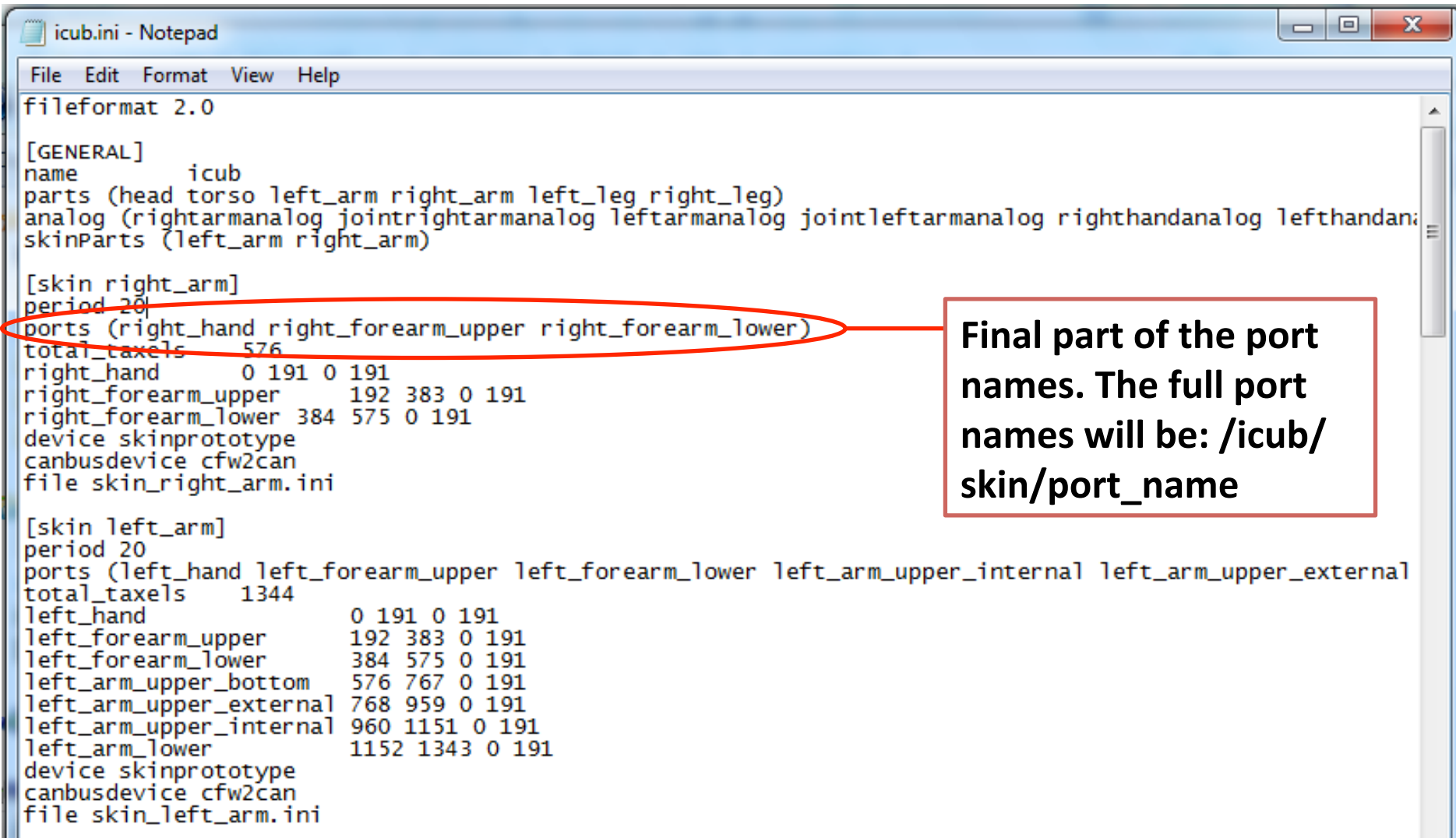


```
icub.ini - Notepad
File Edit Format View Help
fileformat 2.0

[GENERAL]
name icub
parts (head torso left_arm right_arm left_leg right_leg)
analog (rightarmalog jointrightarmalog leftarmalog jointleftarmalog righthandalog lefthandalog)
skinParts (left_arm right_arm)

[skin right_arm]
period 20
ports (right_hand right_forearm_upper right_forearm_lower)
total_taxels 576
right_hand 0 191 0 191
right_forearm_upper 192 383 0 191
right_forearm_lower 384 575 0 191
device skinprototype
canbusdevice cfw2can
file skin_right_arm.ini

[skin left_arm]
period 20
ports (left_hand left_forearm_upper left_forearm_lower left_arm_upper_internal left_arm_upper_external)
total_taxels 1344
left_hand 0 191 0 191
left_forearm_upper 192 383 0 191
left_forearm_lower 384 575 0 191
left_arm_upper_bottom 576 767 0 191
left_arm_upper_external 768 959 0 191
left_arm_upper_internal 960 1151 0 191
left_arm_lower 1152 1343 0 191
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file skin_left_arm.ini
```



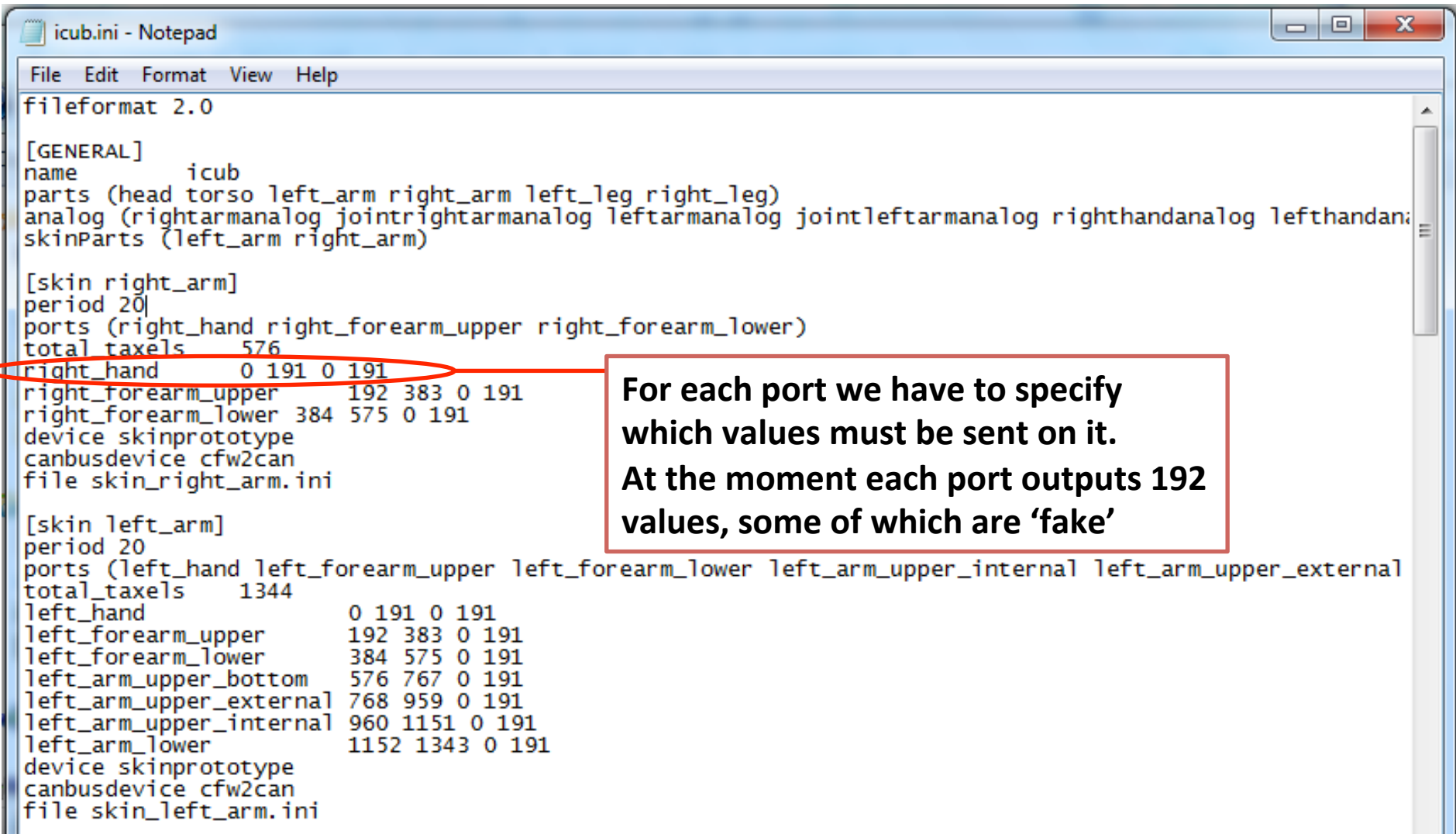
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Final part of the port names. The full port names will be: /icub/skin/port_name



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fileformat 2.0

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```

For each port we have to specify which values must be sent on it. At the moment each port outputs 192 values, some of which are 'fake'

- All the scripts and configuration files related to the skin are located in:
 - `$ICUB_ROOT/main/app/skinGui`
- Let's take a look at this file:
 - `skinGui/scripts/skinGuiAll.xml.template`